(12) EUROPEAN PATENT APPLICATION

(72) Inventor : Takahashi, Kyo
c/o Japan Radio Co. Ltd.,
1-1 Shimorenjaku 5-chome
Mitaka-shi, Tokyo 181 (JP)

(74) Representative : Driver, Virginia Rozanne et al
Page White & Farrer
54 Doughty Street
London WC1N 2LS (GB)

(54) Adaptive equalizer capable of compensating for carrier frequency offset.

(57) An adaptive equalizer includes a multiplier for multiplying, by corrective data, an output signal from a filter unit for compensating for a signal distortion to which input digital data are subjected, a decision unit for estimating and outputting symbols of output data from the multiplier, a subtractor for subtracting an output signal of the decision unit from the output data from the multiplier, multipliers for inversely correcting the output signals from the decision unit and the subtractor which are corrected by the multiplier, a coefficient updating unit for updating the coefficients of the filter unit based on an output signal from the multiplier which inversely corrects the output signal from the subtractor, and a frequency offset estimating unit for estimating corrective data based on a frequency offset on the basis of the output signal from the multiplier which inversely corrects the output signal from the subtractor, and using the estimated corrective data as corrective data for the multiplier which multiplies the output signal from the filter unit by corrective data. An output signal from the multiplier which inversely corrects the output signal from the decision unit is fed back to a feedback filter of the filter unit.

FIG.1
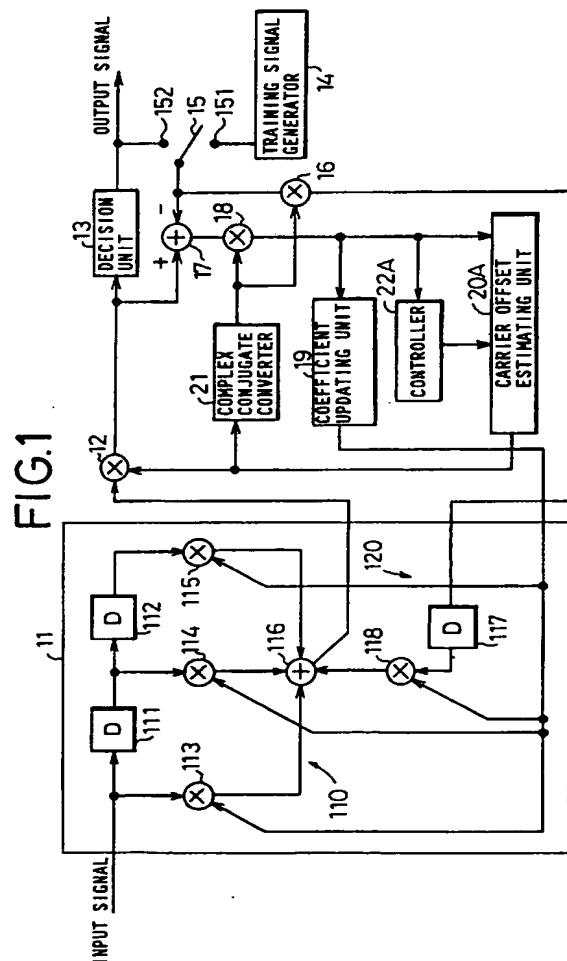
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EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	CA-A-2 067 461 (OKI ELECTRIC INDUSTRY) * page 6, line 33 - page 7, line 3 *	1-3	H04L25/03 H04L27/22
Y	* page 9, line 9 - line 25 *	4	
A	* figure 1 *	5,6,8-12	
Y	NEC RESEARCH AND DEVELOPMENT, no.45, April 1977, TOKYO, JP pages 38 - 49 AKASHI F. ET AL.: 'A HIGH PERFORMANCE DIGITAL QAM 9600 bit/s MODEM' * page 45, left column, line 10 - line 24 *	4	
A	* figures 9,11,12 *	1-3	
Y	US-A-4 532 640 (BREMER ET AL.) * column 1, line 35 - line 55 * * figure 1 *	4	
A	PROCEEDINGS OF THE IEEE, vol.73, no.9, September 1985, NEW YORK, US pages 1349 - 1387 QURESHI S. U. H.: 'Adaptive Equalization' * paragraph G, pages 1356-1357 * * figure 12 *	5,8,9	TECHNICAL FIELDS SEARCHED (Int.Cl.5) H04L
A	EP-A-0 369 406 (NEC) * page 5, line 46 - line 53 *	5,8,9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	6 February 1995	Ghigliotti, L

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid,

namely claims:

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions,
namely:

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☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid,

namely claims:

☐ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims,

namely claims:

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LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims 1-4: Adaptive equalizer including means for correcting a carrier frequency offset at the output of the equalizer filter, and means for reintroducing the carrier frequency offset in the equalizer error signal before using it to update the equalizer tap coefficients and to estimate the carrier frequency offset

2. Claims 5-14: Correction of a carrier frequency offset by accumulating equalization errors at a plurality offset correction values and selecting the offset correction value corresponding to the minimum acculated error